



CA0479



CA0493A



2000 Andrew Gordon
CA0517



CA0691



CA0498

Energy 2001

Fuel Cell Power Generation

June 2001



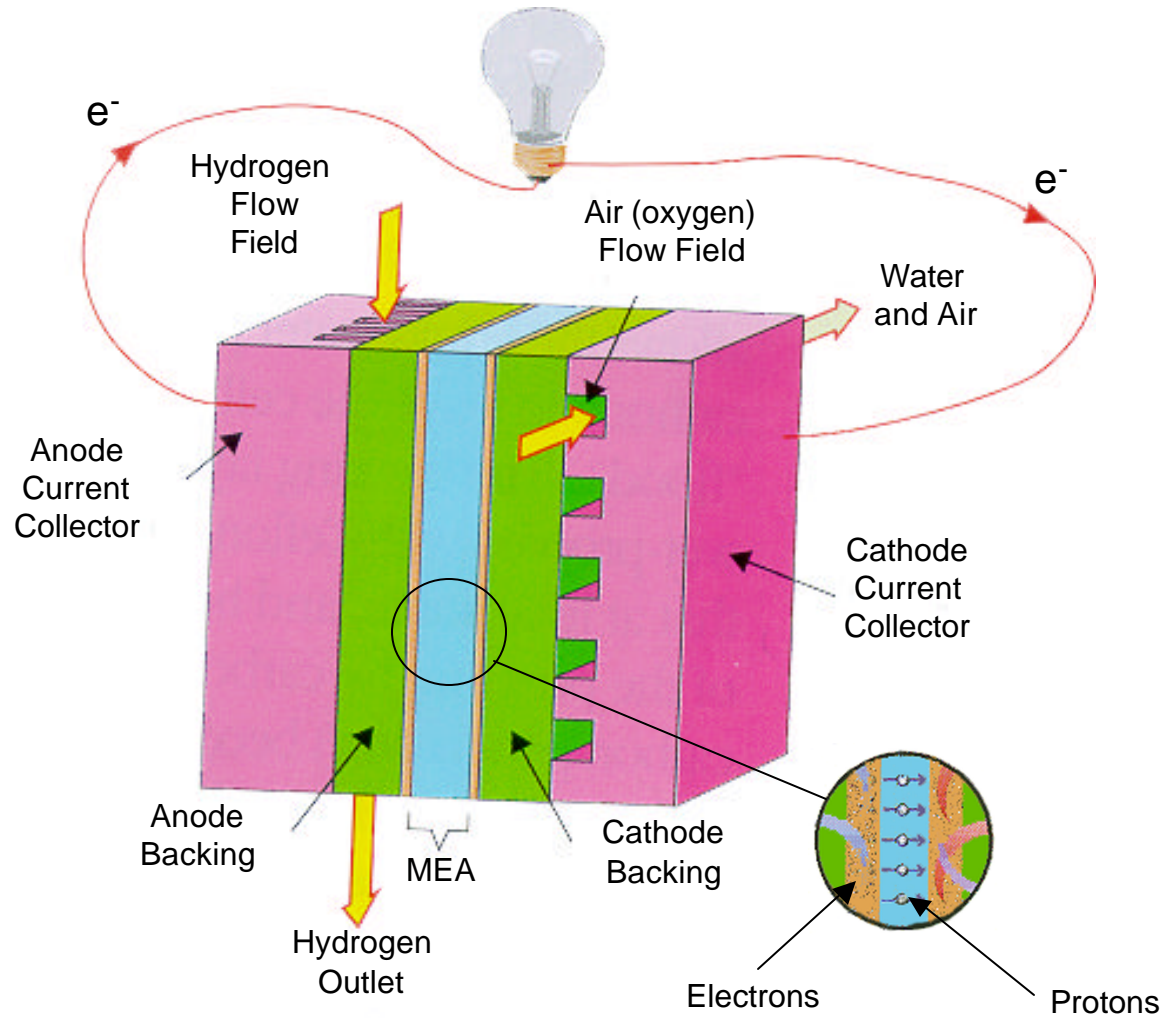
International Fuel Cells

A United Technologies Company






International Fuel Cells
195 Governor's Highway
South Windsor, Connecticut 06074 USA
860-727-2200
www.internationalfuelcells.com

PRE0189

HOW A FUEL CELL WORKS

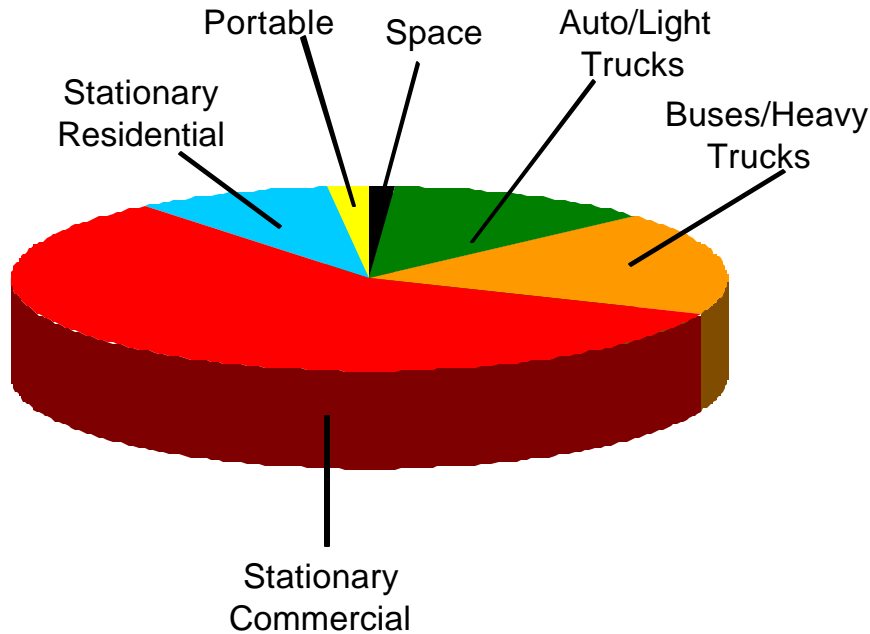


FUEL CELL TYPES COMPARED

	Fuel Cell Type	Applications	Operating Temperature °C	Comments
	Alkaline	Space	80 - 100	Needs pure fuel/oxidant
	Phosphoric Acid	Stationary	200 - 220	Long life Useful heat
	Proton Exchange Membrane	Stationary Transportation	80 - 100	Short start time, Easily manufactured Small size / scalability Limited co-gen
	Molten Carbonate	Stationary	600 - 650	High efficiency Good co-gen Difficult to manufacture
	Solid Oxide	Stationary	650 - 1000	High efficiency Exotic materials Good co-gen

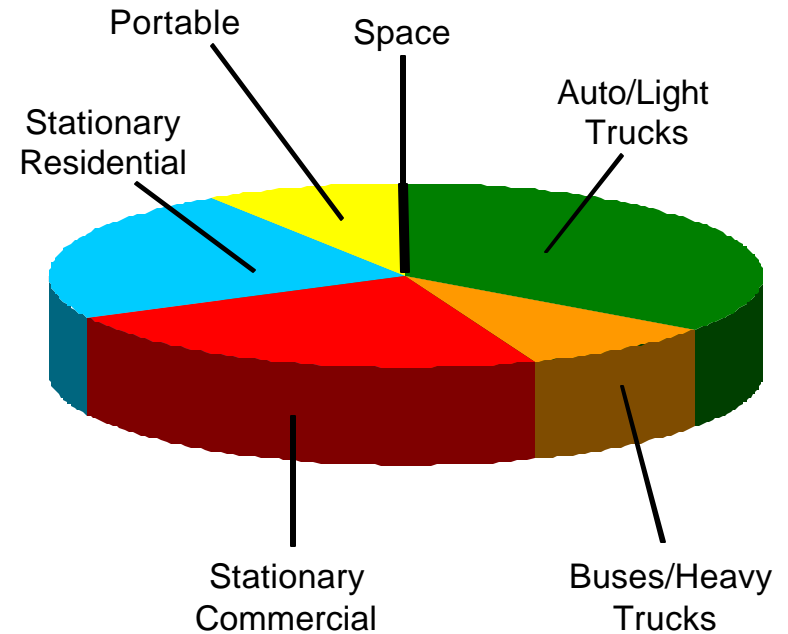
FUEL CELL SEGMENTS

Projected markets



2005

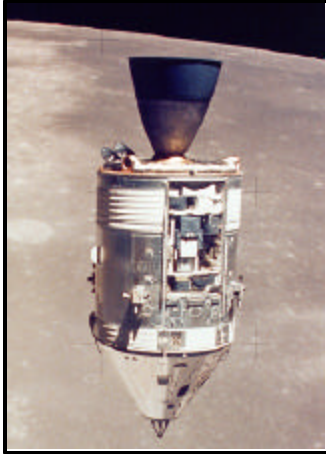
\$1 Billion



2010

\$20 Billion

SPACE FUEL CELL POWER PLANT



APOLLO
1966 - 1978

CN1293

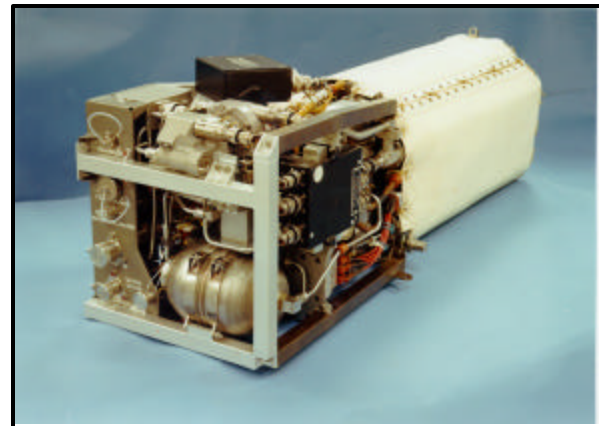


SHUTTLE
1981 - PRESENT

WCN 8986

PC17C Space Shuttle Power Plant

- Alkaline electrolyte
- 12 kW, 260 lb.
- 100 flights to date
- 77,073 hours



1981 - PRESENT

WCN10464

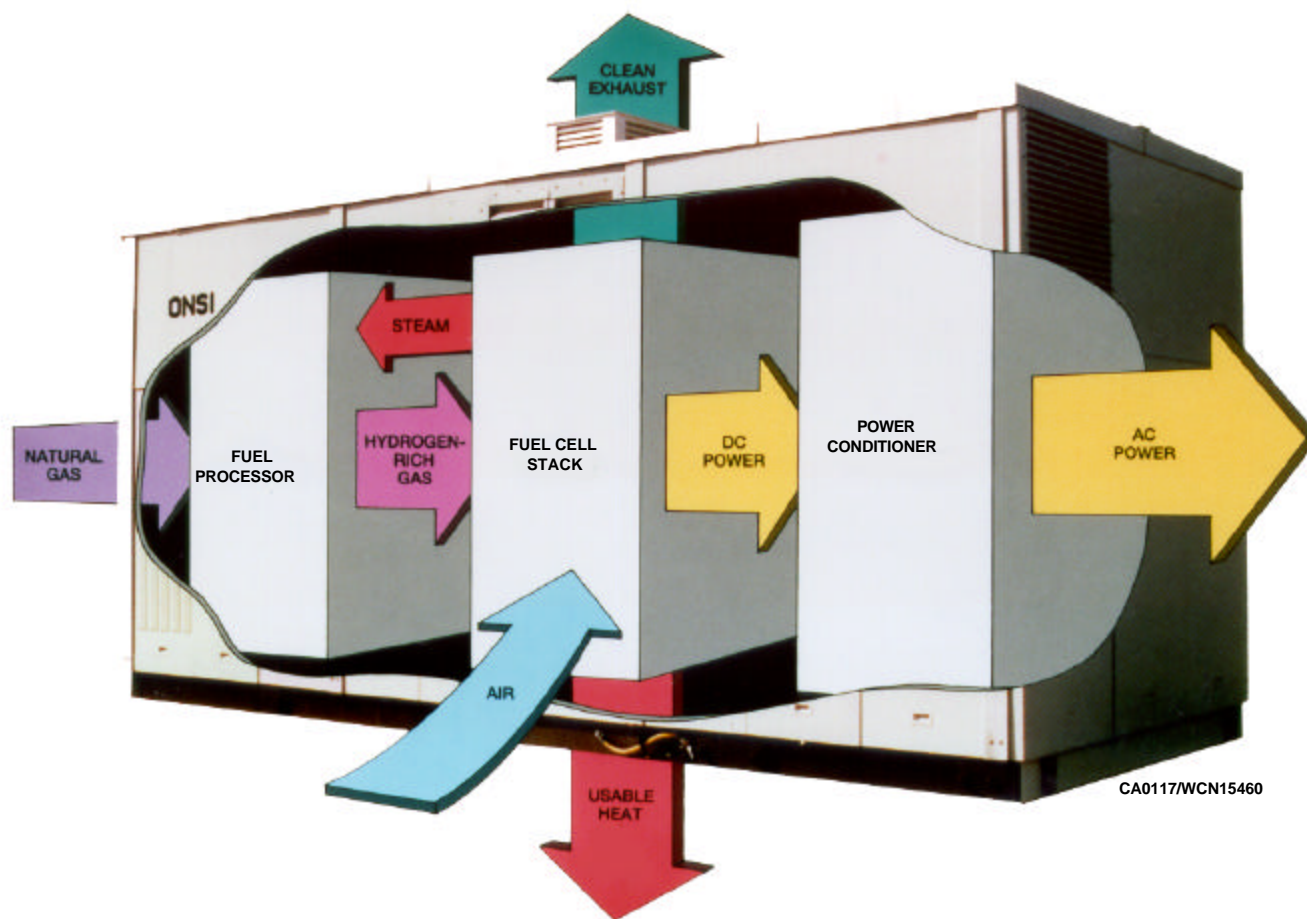
200 KW COMMERCIAL POWER PLANT



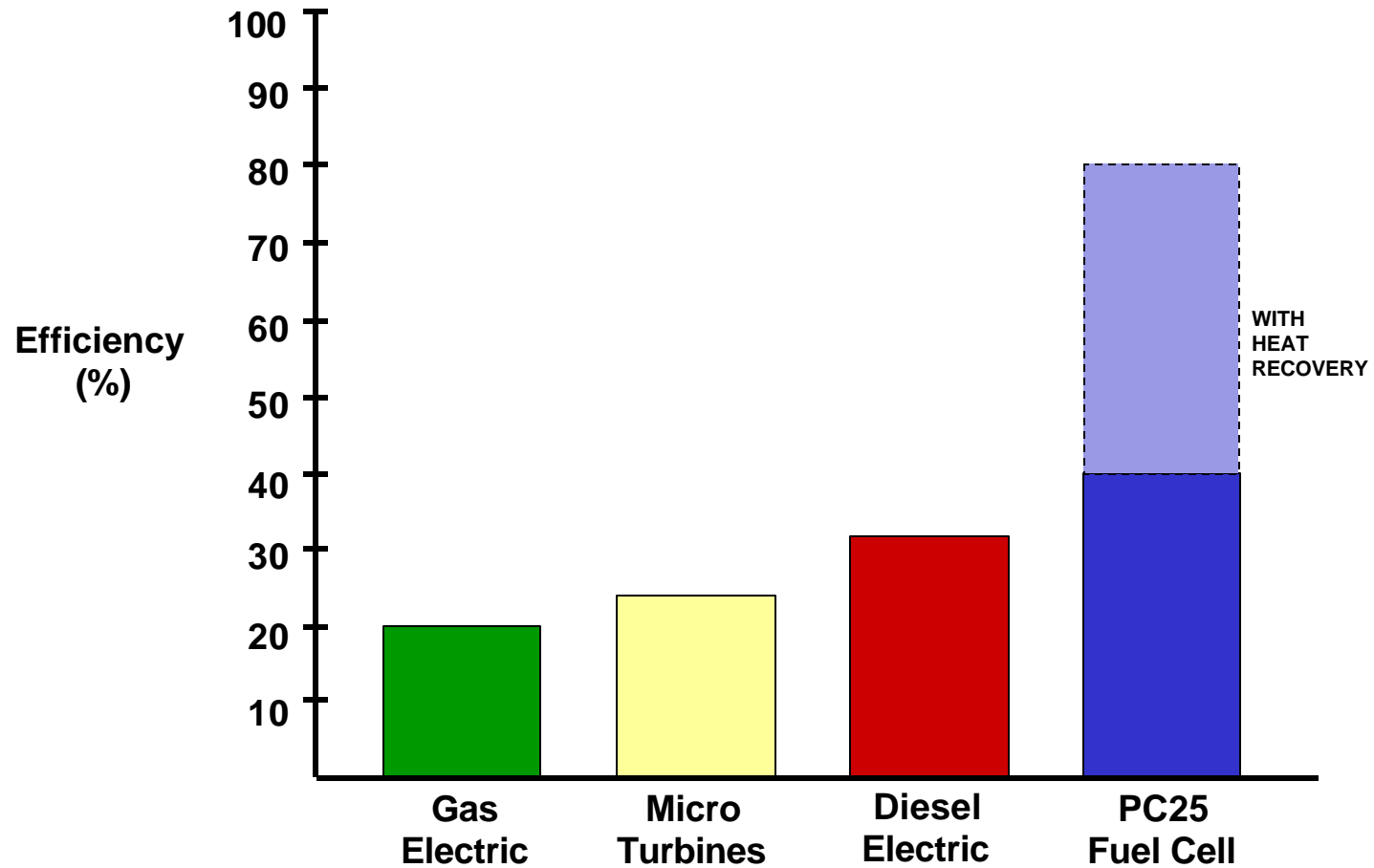
WCN15802

COMPLETE PACKAGED POWER PLANT

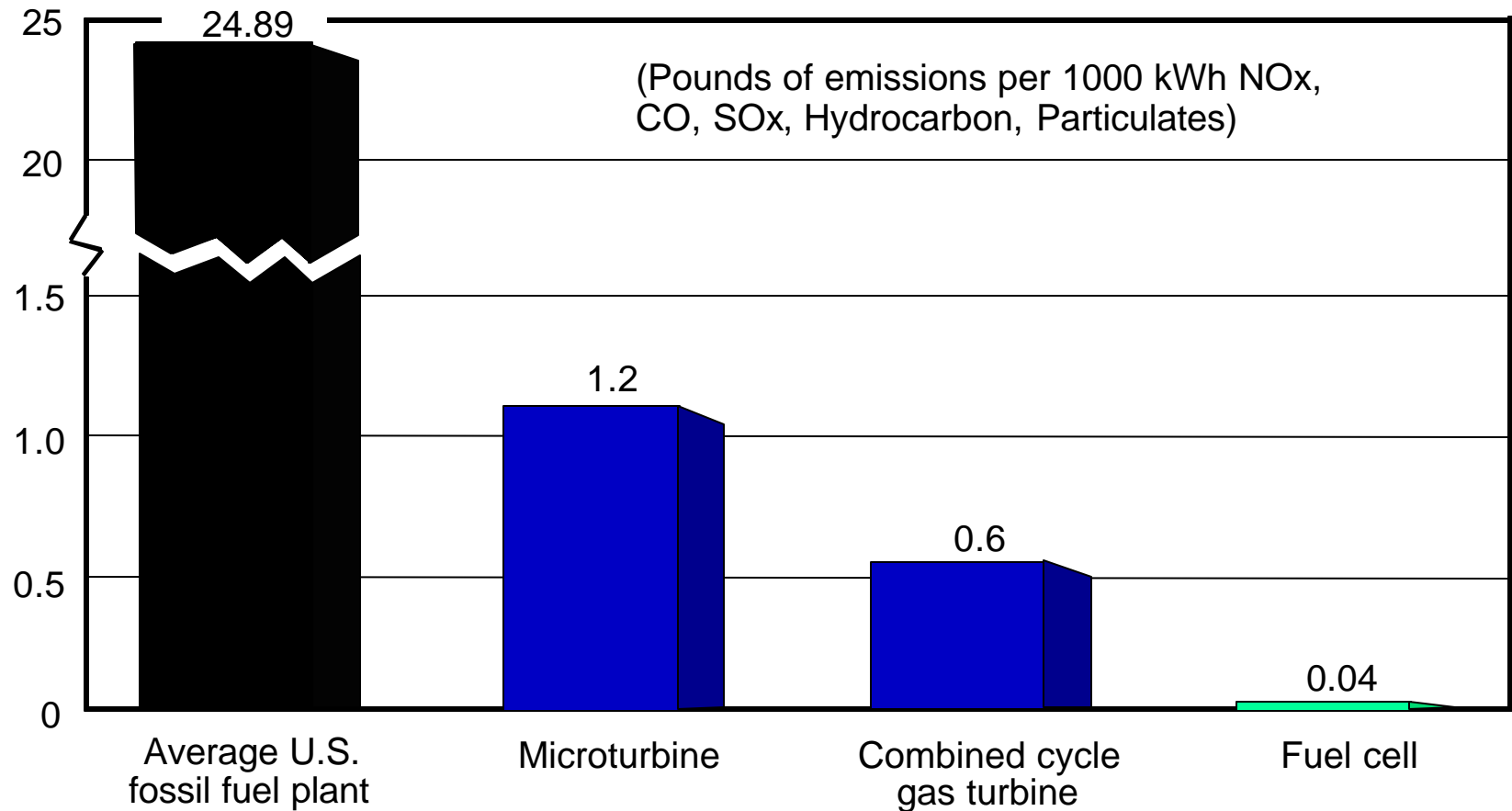
PC25™ C 200 kW fuel cell power plant



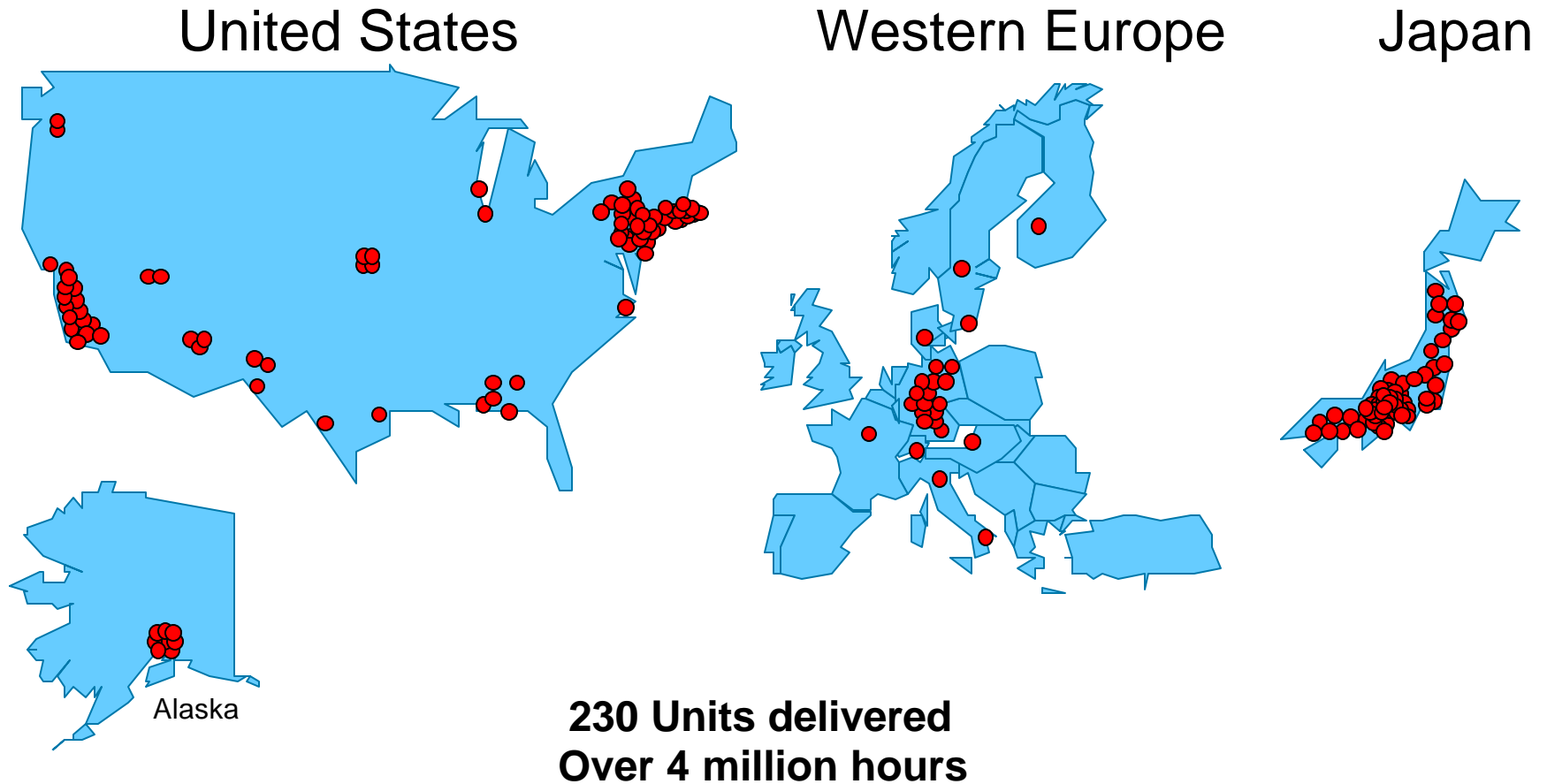
EFFICIENCY COMPARISON



FUEL CELL EMISSIONS



WORLDWIDE EXPERIENCE



COMMERCIAL POWER SYSTEMS

PC25 market focus

UPS SYSTEM



Omaha, Nebraska

1488-1

DISTRIBUTED GENERATION



1487-17

Central Park, NYC, NY

WASTE WATER TREATMENT



WCN-15801

Deer Island, Boston, MA

GREEN POWER/COGENERATION



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CA0517

4 Times Square, NYC, NY

CONVENTIONAL RESPONSE TO RELIABILITY

UPS system



DISTRIBUTION LINES

1532-16



UPS SWITCH

1532-09



COMPUTER BANK
CRITICAL LOAD

1532-04



BATTERY STRING

1531-01



GENERATOR

1531-03

IFC HIGH 9's

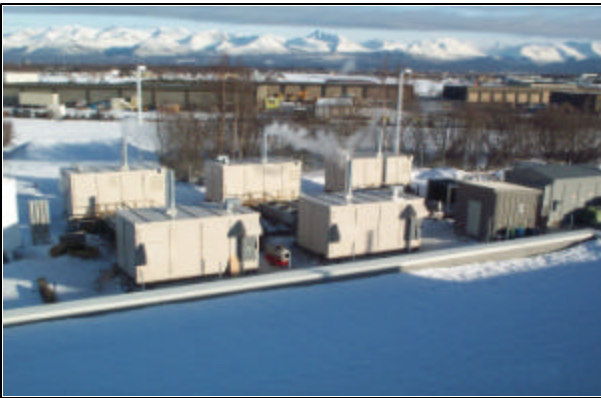
Application

Performance



Bank One data
center
Omaha
99.9999%

\$6 million dollars lost per day
outage
800 kW installation
2 years in service, zero outages



US Postal Center
Alaska
99.999%

Average 1 outage per week; 2
shifts of lost productivity per outage
1 MW installation
Online since August 2000 with zero
outages



Regional computer
center
New York
99.99%

Average of 1 outage per
month before installation
3 years in service
zero outages

ON-LINE EMERGENCY POWER

South County Hospital, Rhode Island



WCN16287d



WCN16278SM

• 99.99%

FUEL CELL INSTALLATIONS AT SCHOOLS



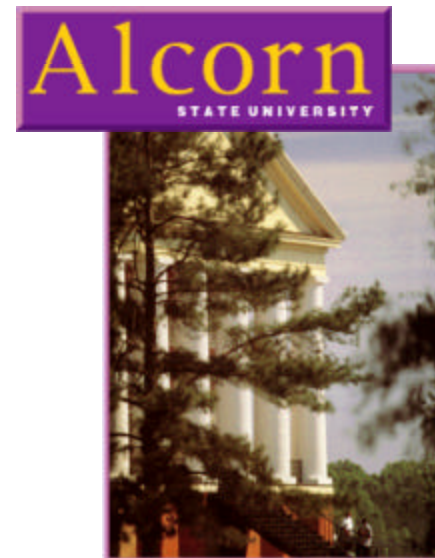
BOCES, Syracuse, NY CA0675



Liverpool High School, NY CA0348



Ramapo College, NJ CA0865



Alcorn State University, MS CA00864

DISTRIBUTED GENERATION

Central Park Police Station



1487F17

USE OF ADG FUEL

Waste water treatment plant, Boston, Massachusetts



WCN-15800

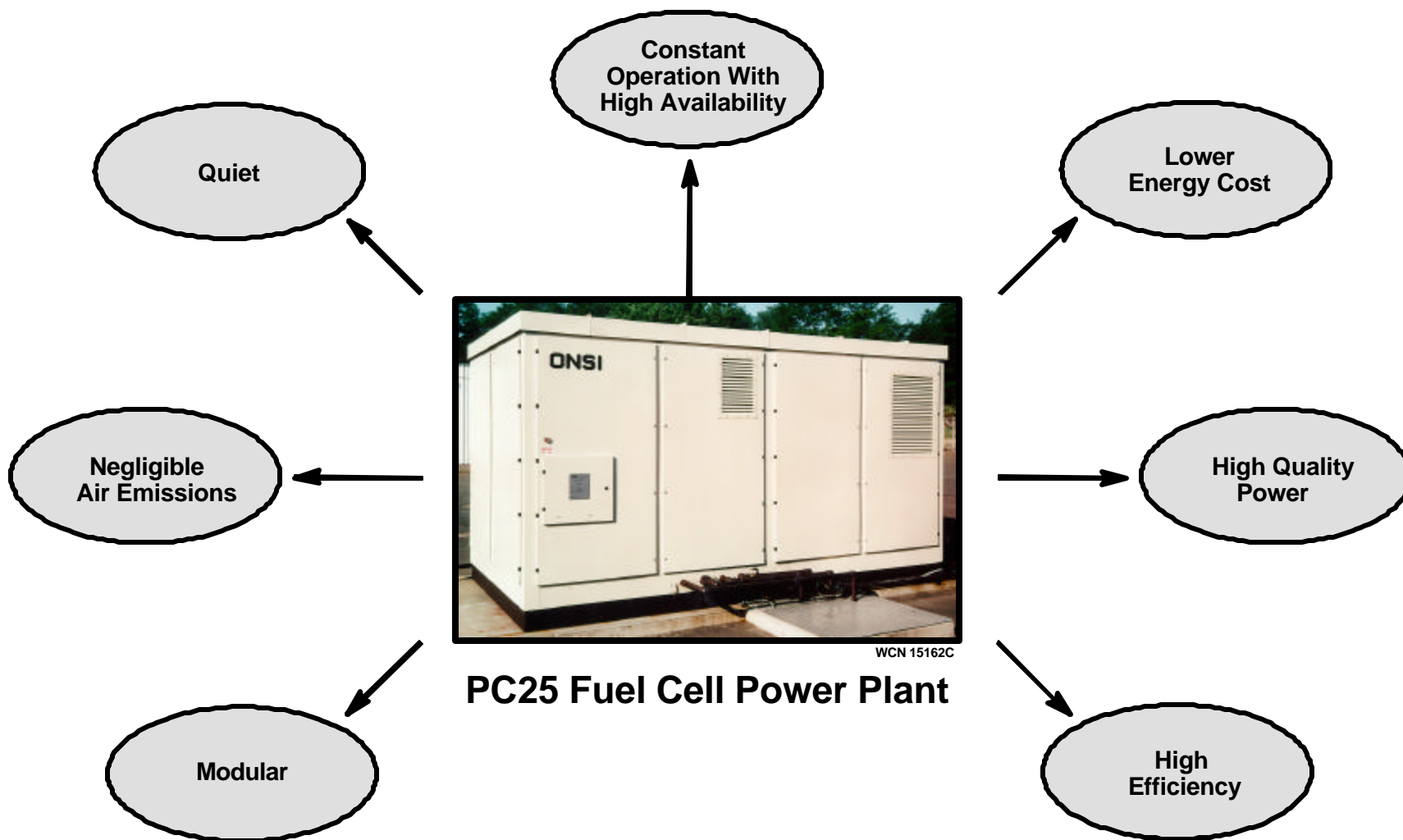
GREEN COGENERATION

4 Times Square



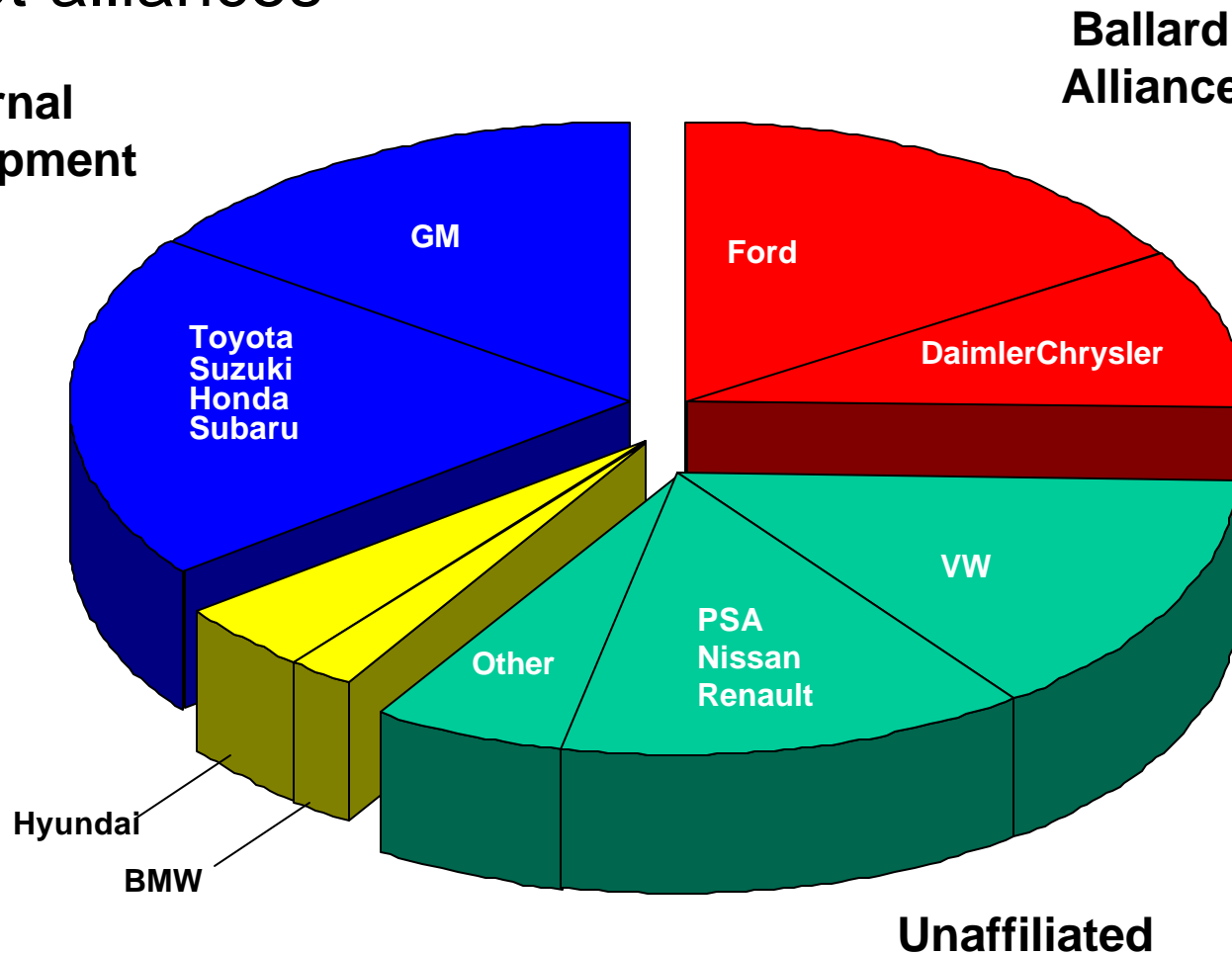
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CA0517

PC25™ POWER PLANT ADVANTAGES



AUTOMOTIVE

Market alliances



50 million vehicles

BMW

Auxiliary power unit (APU)

“No Battery Required”



CA0685-1



1451f22

- 5 kW
- Non-traction power
- Zero emissions
- Hydrogen



1445-3

HYUNDAI

Santa Fe - Fuel Cell Vehicle

“Coming in 2001”

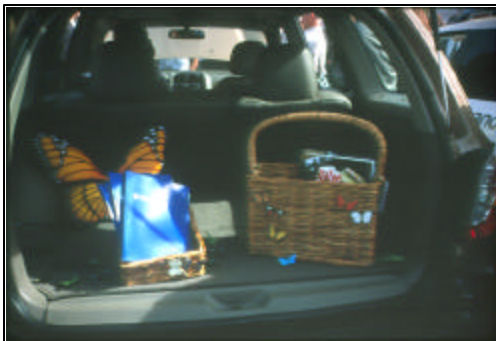


- Zero emissions
- Quiet



CA0710

- Efficient
- No intrusion into passenger or cargo space



CA0765

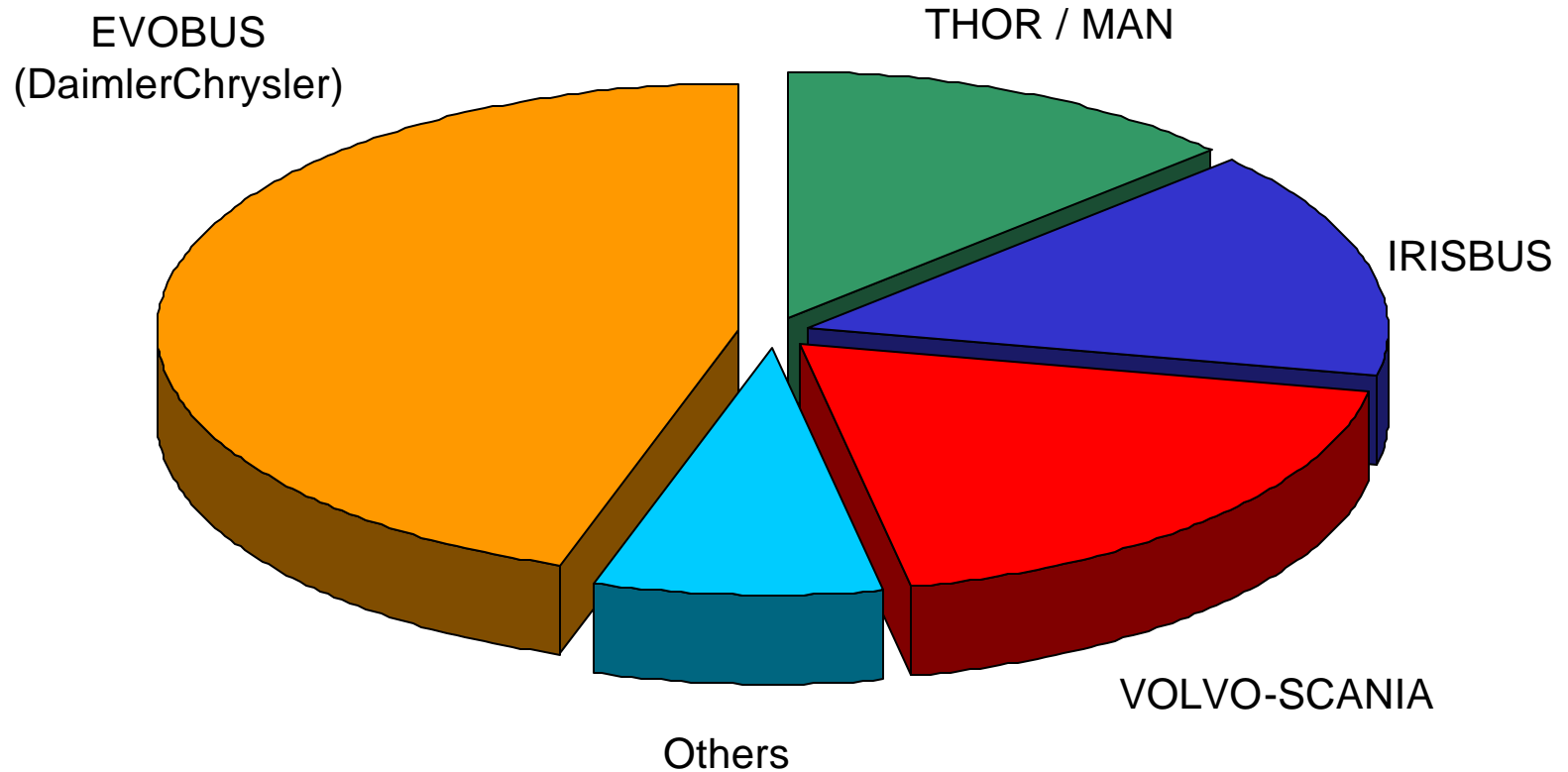
- Superior performance
- 6 months - sign to drive



CA0757

BUS

North America and Europe market



65,000 UNITS

BUS APPLICATIONS

“Fleet Vehicles”



CA0576-1

IRISBUS - Europe



CA0691

Thor - U.S.

- Hybrid configurations
- Zero emissions
- Quiet
- Superior efficiency

LIGHT COMMERCIAL/RESIDENTIAL POWER PLANT

Scale 5 kW Power Plant.



Residential Power Plant Model

EARLY-ADOPTER APPLICATIONS



CA0790

ASSURED LIGHT
COMMERCIAL



CA0727

OFF-GRID
RESIDENTIAL



CA0884

CHP FOR
MULTIFAMILY HOME
(EUROPE & ASIA)

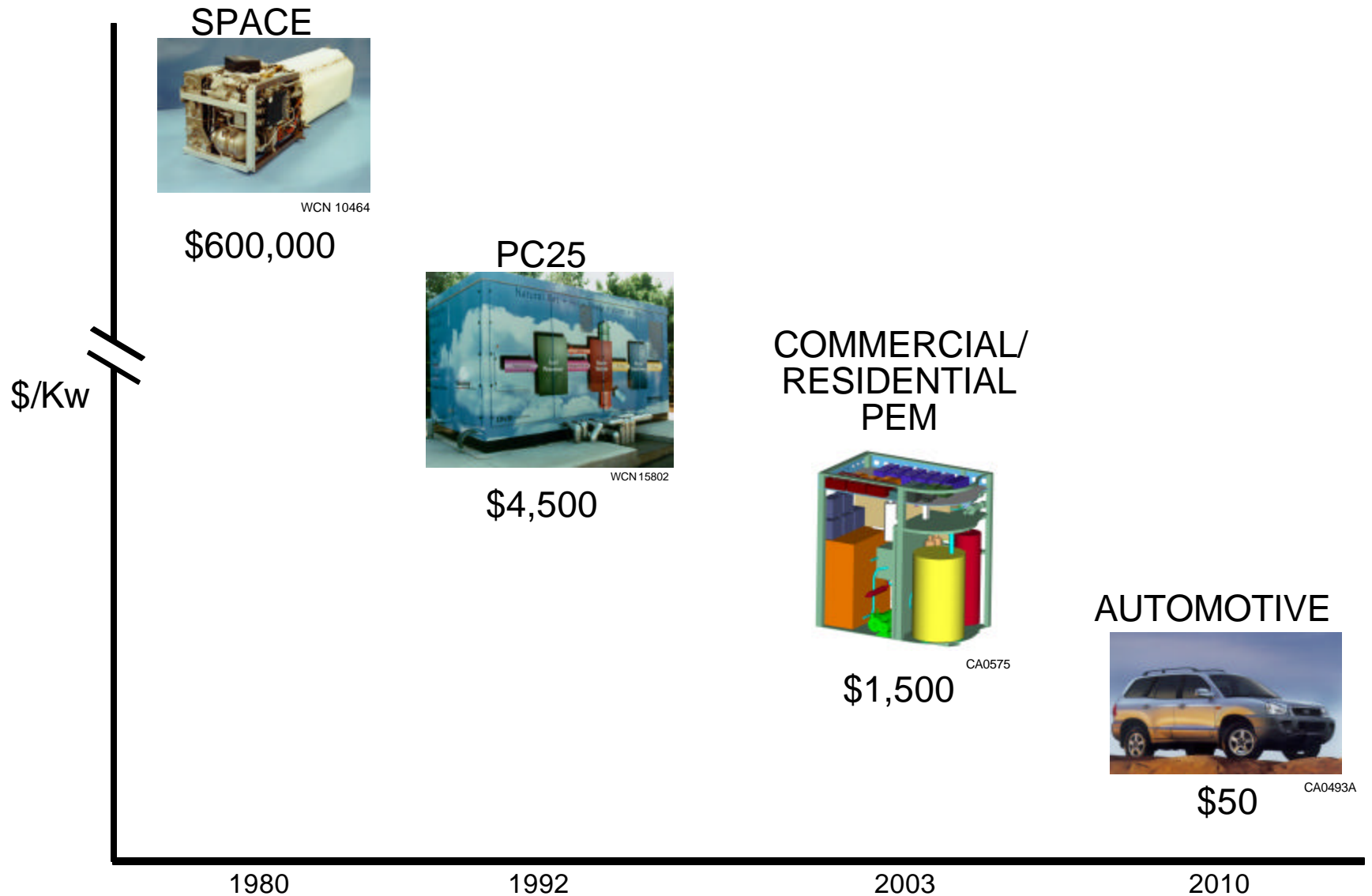


CA0498

ASSURED
HOUSE POWER

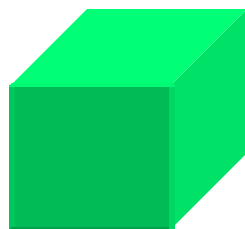
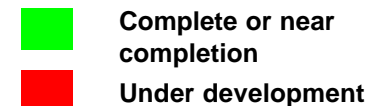
VOLUME
PRODUCT MATURITY
REDUCED COST

COST REDUCTION

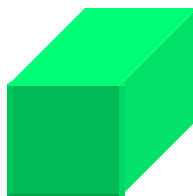


TECHNOLOGY DEVELOPMENT

Stack size comparison - 50 kW



Phosphoric Acid
PC25



Phosphoric Acid
Bus



PEM
Series 200



PEM
Series 300

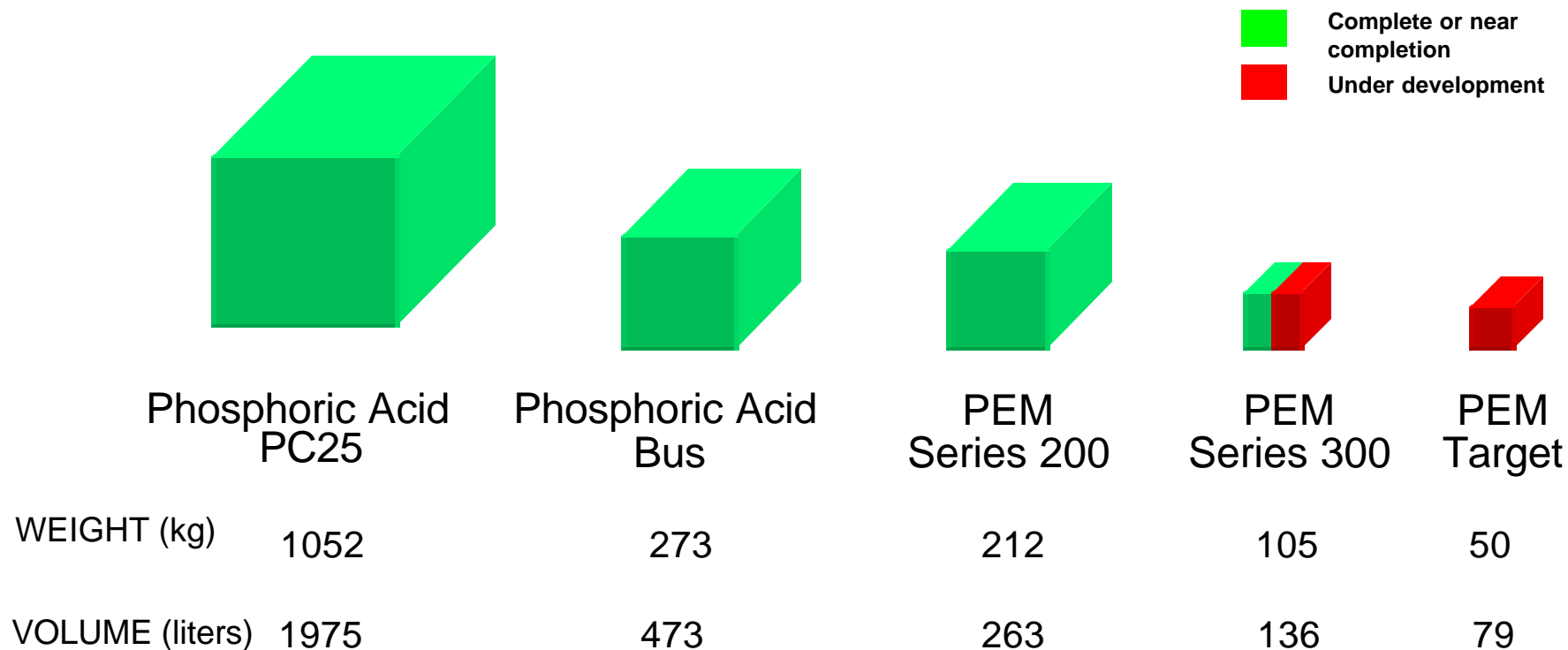


PEM
Target

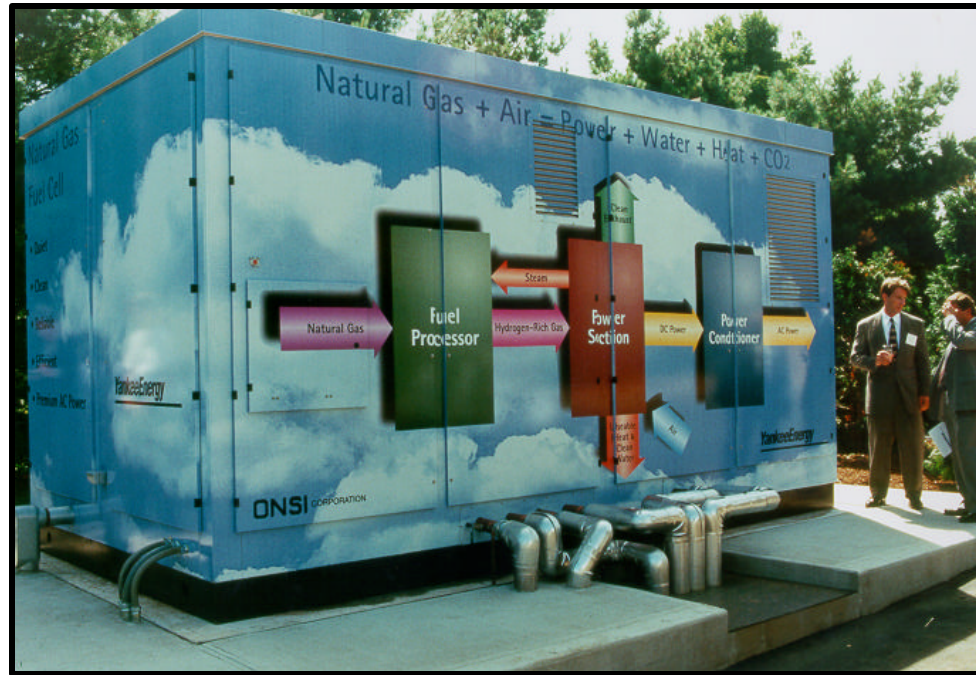
WEIGHT (kg)	739	273	102	55	37
VOLUME (liters)	745	337	118	47	36

TECHNOLOGY DEVELOPMENT

Fuel size comparison - 50kW



IFC - World's Leading Fuel Cell Company



WCN15802

- 40 years of fuel cell experience
- 400 power plants delivered
- World's only space fuel cell
- World's only commercial fuel cell product
- Over 4 million hours of commercial power plant operating experience
- www.ifc.com